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Comment

Trifonov's Meta-Definition of Life

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What is a Definition in the Realm of Biology?

The problem of *definition* is at the basis of the problem of *understanding*. Any level of understanding of any natural phenomenon or object entails its *description*, followed by the comparison (in our brain or in the pages of an Herbarium, or by a computer program) with similar phenomena or objects. Between comparison and understanding we encounter *classification*. The problem of classification is not solved.

The tradition we are acquainted with is the Linnaean System. Simplifying (too much, I am afraid), according to this system every organism belongs to a Species and to a Genus. The properties allowing the organism to be encased in a Species are, in semiological terms, Dictionarian (that is: "context-free"). The characters for the Genus are Encyclopaedian ("context-dependent"). Given that the two categories are based on principles that do not belong to the same category, in terms of logics the System is ambiguous. Linnaean classification has had some use essentially because it empirically approximates the definiendum to the closest functional happenstance. The upper floors of the System (Families, *etc*.) suffer from the same approximation. Similar ambiguities characterize other Systems. Aristotelian classification was, in spite of its almost bi-millennial life, even more logically ill-based. To the point that when a careful analysis was made, it was recognized by Porfirius that applying its principles with some rigour one would quickly hit the limit set by *penuria nominum,* scarcity of names, impossibility to classify providing the appropriate labels.

The era of genomics has clarified this point with precision. Each genome is itself: similarities abound, as differences do. The basic structural, functional and informational principles of living entities are the same since the very beginning of their history.

These principles essentially consist of the organization of a genotype (the *egg*) gathering, maintaining and transmitting information related to itself and to a phenotype (the *chicken*), harnessing and directing energy and matter into the further organization, maintenance and transmission of the egg. From the earliest information to the extant enormous (and informationally limitless) genomes no interruption exists (by definition), no firm border can be traced. Shuffling genes from one genome to others, constructing genetic chimaeras made of genes originated in different Kingdoms or, simply, just performing meta-genomics of flasks of sea water shows the principle of *penuria nominum* in contemporary terms. In the realm of biology there are no barriers, definitions are elusive.

That's where Trifonov's thought comes into play.

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A Radical Approach

The contribution of this paper is in its hidden radical criticism, and in the solution it proposes.

My personal opinion is that no acceptable definition of life exists, yet. According to the most popular one, life is "a self-sustained chemical system capable of undergoing Darwinian evolution" (2). This is very close to the definition provided by Oparin: "Any system capable of replication and mutation is alive" (3). However, life is a process, not a system. In addition, if a definition relies on the variation (evolution) of its definiendum, it is intrinsically a description, more than a definition. This does not diminish its empirical value, in a sense very close to what we have mentioned about the purport of the Linnaean classification System. Rather, these two definitions help to make the point: we are dealing with descriptions, not definitions.

Trifonov's title implies exactly this: all definitions are relative.

Corollary: a relative definition is not a definition. In a given frame of reference a law is absolute, or is not. Comparing the proposed definitions, as he does, is extremely useful (and original). Especially so if done with the rigour and the wide-angle that characterize his Gnomic (4) approach. What turns out is that comparing the definition distilled from his reported tabulation of the 123 definitions analyzed (namely: "life is self-reproduction with variations") with the currently most accepted "life is a self-sustained chemical system capable of undergoing Darwinian evolution", the only common term is "*self*". Which may well be the final minimalist definition of life, encompassing them all.

A Way Out from Ambiguity

The difference between description and definition is not just semantics, is categorical. May the two categories be reconciled? Trifonov's reasoning provides a solution: at the cross between the two lays, in the realm of biology, Darwin's warm little pond (5). There is where it is believed that everything started, where the first molecules began accumulating, replicating and evolving information. His three decades-long Gnomic approach consists of the compilation and analytical comparison of essentially all that is known about sequences (nucleic acids, proteins and, in between, coding functions) looking for the very first principles. Gnomic is description aiming to definition.

I believe that he has come very close to the solution: "The earliest steps of the evolution of the codons also suggested two major stages in the origin of life – self-reproduction (exact replication of the ideal RNA duplex in the above theory, one strand of which is repeating triplet GCC_n, while another strand is complementary GGC_n), and variations (appearance of point-mutated versions of GCC and GGC in the subsequent replications)." (1, and references therein). Accordingly, studies involving the $GCC_n{}^*GGC_n$ replicator border the life-non life transition (6), reducing it to initial experimental analysis (7). The identification of plausible first replicators would help to pinpoint the events that lead from dis-order to order, and ignite the process that we are struggling to define, the first "selves".

I thank E. N. Trifonov for bringing up the important and often overlooked definition in reference 3.

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